

ORIGINAL ARTICLE

Door-to-balloon Time in Cardiovascular Emergency Care in a Hospital of Northern Brazil

Tárcio Sadraque Gomes Amoras,^{1,2} Taymara Barbosa Rodrigues,^{1,2} Cláudia Ribeiro Menezes,³ Christielaine Venzel Zaninotto,² Roseneide dos Santos Tavares³

Universidade do Estado do Pará,¹ Belém, Pará - Brazil

Fundação Hospital de Clínicas Gaspar Vianna,² Belém, Pará - Brazil

Universidade Federal do Pará - Faculdade de Enfermagem,³ Belém, Pará - Brazil

Abstract

Background: The use of an adequate door-to-balloon time (≤ 90 minutes) is crucial in improving the quality of care provided to patients with ST-segment elevation myocardial infarction (STEMI).

Objective: To determine the door-to-balloon time in the management of STEMI patients in a cardiovascular emergency department in a hospital of northern Brazil.

Methods: This was a cross-sectional study based on review of medical records. A total of 109 patients with STEMI admitted to the emergency department of a referral cardiology hospital in Pará State, Brazil, between May 2017 and December 2017. Correlations of the door-to-balloon time with length of hospital stay and mortality rate were assessed, as well as whether the time components of the door-to-balloon time affected the delay in performing primary percutaneous coronary intervention. Quantitative variables were analyzed by Spearman correlation and the G test was used for categorical variables. A $p < 0.05$ was set as statistically significant.

Results: Median door-to-balloon time was 104 minutes. No significant correlation was found between door-to-balloon time and length of hospital stay or deaths, but significant correlations were found between door-to-balloon time and door-to-ECG time ($p < 0.001$) and ECG-to-activation (of an interventional cardiologist) time ($p < 0.001$).

Conclusion: The door-to-balloon time was longer the recommended and was not correlated with the length of hospital stay or in-hospital mortality. Door-to-ECG time and ECG-to-activation time contributed to the delay in performing the primary percutaneous coronary intervention. (Int J Cardiovasc Sci. 2021; 34(1):53-59)

Keywords: Myocardial Infarction; Angioplasty, Balloon, Coronary; Admitting Department, Hospital; Time to Treatment; Quality Indicators; Health Care.

Introduction

Primary percutaneous coronary intervention (PCI) is the safest strategy for the treatment of ST-segment elevation myocardial infarction (STEMI).¹ According to the Brazilian Society of Cardiology (SBC) and the American Heart Association guidelines, the time from arrival at the initial hospital to the time of the first balloon inflation during primary PCI, defined as door-to-balloon time, should be within 90 minutes.²

In Brazil, adherence to health care guidelines by healthcare centers is still lower than expected,³

resulting in a suboptimal performance of these services, compromising the quality of care and safety of patients.^{2,4} Current scientific evidence indicates that adherence to good clinical practice guidelines leads to better performance, reducing morbidity and mortality, length of hospital stay, and costs with STEMI patients, in addition to improve patients' safety and satisfaction.⁵⁻⁷

Door-to-balloon time has been used worldwide as an indicator of quality of care, helping to monitor the achievement of aims and goals of health care,³⁻⁵ foster the strengthening of analytical capacity of the teams involved

Mailing Address: Tárcio Sadraque Amoras

Travessa Angustura, 2219. Postal Code: 66113-200, Pedreira, Belém, Pará - Brazil

E-mail: tarcioamoras@hotmail.com, tarcioamoras@hotmail.com

in the management of patients with STEMI and make it as close to ideal as possible.⁸

Therefore, the present study aimed to measure door-to-balloon time and correlate it to the number of deaths and length of hospital stay. We also evaluated whether time intervals of the door-to-balloon time influence on delayed primary reperfusion (wire crossing) at the emergency department of a cardiology hospital in the State of Pará, Brazil.

Methods

This was a cross sectional cohort study based on review of medical records. Patients of both sexes, aged ≥ 18 years, with confirmed diagnosis of STEMI were included. All patients had undergone reperfusion within 12 hours after precordial pain and were hospitalized at the emergency department of Gaspar Viana General Hospital Foundation (FHCGV) between May and December 2017. The HCGV is a referral center for heart disease in Pará, Brazil, and the only public hospital for medium and highly complex heart diseases, heading the health care line of myocardial infarction patients among the 144 cities of the state. A total of 109 patients were included in the study.

The following data and variables were systematically collected: age, sex, ethnicity, geographic origin, risk factors, length of hospital stay, number of deaths, and door-to-balloon time and its components.

Since May 2017, to monitor the quality of care provided to STEMI patients in FHCGV, door-to-balloon time and its component times have been prospectively measured using a checklist completed by the staff. The following times were measured: door-to-ECG time (Δt_1), time between the electrocardiography test (ECG)

and activation of an interventional cardiologist (Δt_2) (ECG-to-activation time), time for patient preparation (activation-to-patient preparation) (Δt_3), time between patient preparation and beginning of reperfusion (Δt_4), time between beginning of reperfusion and balloon inflation (Δt_5), time between activation and arrival of an interventional cardiologist at the cath laboratory (Δt_6) (Figure 1).

Data collection was conducted after the study was approved by the Ethics Committee of the FHCGV (approval number 2.527.630).

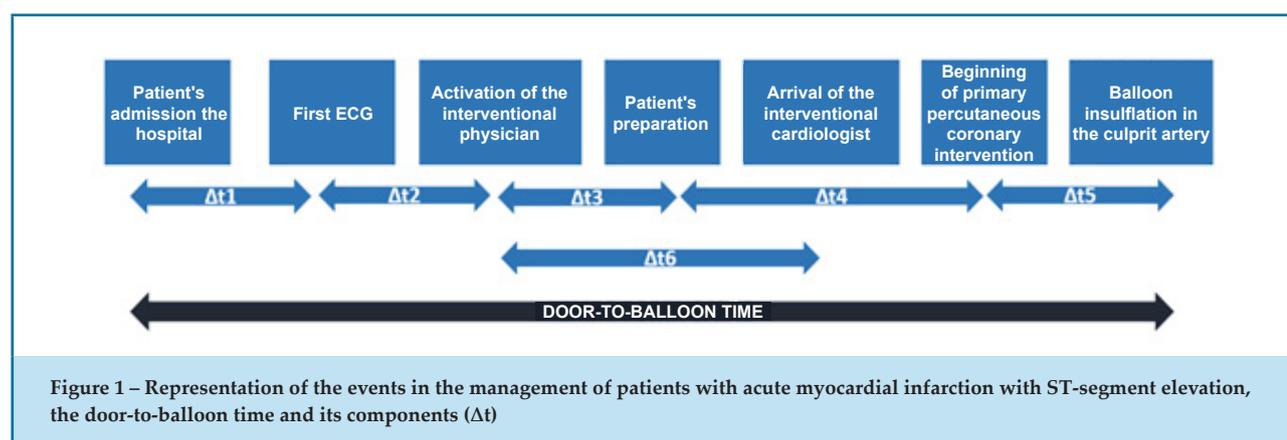
Outcome Measures

Door-to-balloon time was described as a numerical variable and defined as a primary outcome. The proportion of patients with adequate door-to-balloon time (≤ 90 minutes), and the components (Δt) of the door-to-balloon time were registered as secondary outcomes.

Door-to-balloon time was defined as the time from patient's arrival at the hospital to the time of mechanical reperfusion of the culprit coronary artery. The first balloon inflation during the primary PCI. "Door" was defined as the time of registration of the patient in the emergency department. "Balloon" was defined as the exact time of mechanical reperfusion of the coronary artery during PCI, determined by the interventional cardiologist.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 22. Continuous variables with normal distribution were described as mean and standard deviation and



those without a normal distribution were described as median and interquartile range. Normality of data distribution was verified using the Kolmogorov-Smirnov test. Associations between variables were assessed by Spearman correlation (for quantitative variables) and the G-test for categorical variables. The G-test was chosen as it makes no assumptions about the size of the classes. The level of significance was set at 5%.

Results

Characteristics of the Sample

Most patients (78.9%) were male; 64.2% self-identified as "pardo". Mean age was 61 ± 10.88 years and 69.7% came from the metropolitan area of the city of Belem, Brazil. Among the risk factors for acute myocardial infarction, 63.3% of patients were hypertensive, and

Table 1 – Characteristics of the sample	
Variables	N = 109
Sociodemographic data	
Age (years)	61.11 ± 10.879
Male sex	86 (78.9%)
Pardo ethnicity	70(64.2%)
Metropolitan area of Belem (origin)	76(69.7%)
Risk factors	
Arterial hypertension	69 (63.3%)
Smoking	58 (53.2%)
Alcohol consumption	46 (42.2%)
Diabetes mellitus	32 (29.6%)
Infarction presentation	
Symptom duration on admission (hours)	6 ± 3.116
Anterior wall infarction	49 (45%)
Anterior descending artery occlusion	54 (49.5%)
Right coronary artery occlusion	41 (37.6%)
Circumflex artery occlusion	10 (9.2%)
Deaths	9 (8.3%)
Length of hospital stay (days)	7.77 ± 11.94

Source: Division of medical and statistical support of Gaspar Viana General Hospital Foundation, between May and December 2017. Data presented as mean \pm standard deviation or number (percentage)

53.2% of the sample were smokers. Mean time from symptom onset to hospital arrival was approximately 6 ± 3.116 horas. In 48.4% of the cases, there was lesion of the anterior wall. In-hospital mortality was 8.3% and mean length of hospital stay was 7.77 ± 11.94 days. Other clinical characteristics are listed in Table 1.

Mean and median door-to-balloon time was 115 ± 55.3 minutes and 104 minutes, respectively. Time components of the door-to-balloon time are described in Table 2.

Median door-to-balloon time was 121 minutes and 78 minutes for those cases where door-to-balloon time was > 90 minutes (62.4%) and ≤ 90 minutes (37.6%), respectively (Figure 2).

Both door-to-ECG time ($\Delta t1$) and ECG-to-activation time ($\Delta t2$) were significantly correlated ($p < 0.001$) with door-to-balloon time. No statistical correlation was found between door-to-balloon time and length of hospital stay or in-hospital mortality.

Discussion

In the present study, most patients with STEMI were male. According to current evidence, cardiovascular diseases are more prevalent in men than women.^{1,3} In addition, men tend to seek medical care less often than

Table 2 – Door-to-balloon time and its components in the management of patients with acute myocardial infarction with ST-segment elevation. Time in minutes, presented as median and interquartile range (IQR) (n=109)	
Time intervals	Median (IQR)
Door-to-balloon time	104 (18 – 133)
Door-to-ECG time ($\Delta t1$)	11 (5 – 18)
ECG-to-activation time ($\Delta t2$)	10 (5 – 18)
Activation-to-patient preparation time ($\Delta t3$)	10 (5 – 15)
Patient preparation-to-PCI initiation time ($\Delta t4$)	15 (0 – 45)
PCI initiation-to-balloon time ($\Delta t5$)	20 (0 – 30)
Activation-to-arrival of the interventional cardiologist ($\Delta t6$)	25 (0 – 38)

Source: Statistical database of the Cardiology Department of Gaspar Viana General Hospital Foundation between May and December, 2017. PCI: percutaneous coronary intervention

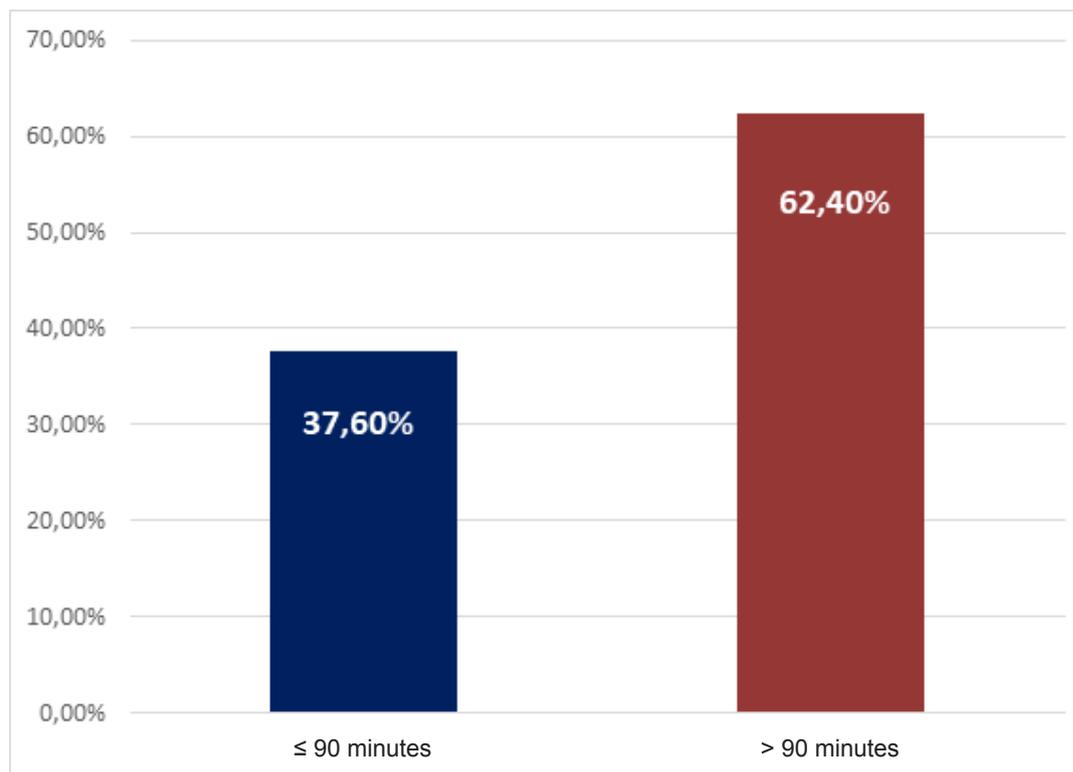


Figure 2 – Distribution of patients according to Door-to-Balloon Time > or ≤ 90 minutes, Belém-Pará, 2018 (n = 109)

Source: authors. 2018.

Table 3 – Correlation between door-to-balloon time and its components (n=109)

Components of the door-to-balloon time	Spearman correlation coefficient	p-value*
Door-to-ECG time (Δt_1)	0.535	< 0.001
ECG-to-activation time (Δt_2)	0.521	< 0.001
Activation-to-patient preparation time (Δt_3)	-0.005	0.961
Patient preparation-to-PCI initiation time (Δt_4)	0.130	0.209
PCI initiation-to-balloon time (Δt_5)	0.168	0.103
Activation-to-arrival of the interventional cardiologist (Δt_6)	0.085	0.385

Source: Statistical database of the Cardiology Department of Gaspar Viana General Hospital Foundation between May and December 2017. PCI: percutaneous coronary intervention; * Spearman correlation

women, due to greater difficulty in identifying and facing possible health problems, in accepting changes in lifestyle and talking about problems. Therefore, in general, instead of seeking preventive medical services, men go to the doctor when disease is already established and there is little chance of recovery, leading to irreversible changes in health and quality of life.^{9,10}

Age of the study population ranged from 60 to 69 years, with mean of 61 ± 10.88 years. Studies have shown that this is the age range of patients who suffer an acute myocardial infarction, due to development of atherosclerotic plaque on the coronary artery wall. Development of early fibroatheroma starts in adolescence and second decade of life and continues throughout life. Advanced atheroma occurs in individuals older than 55 years of age. At this stage, a thin fibrous cap, formed by the activity of proteolytic enzymes, may rupture, exposing the thrombogenic arterial wall, leading to thrombosis.¹¹

Hypertension, smoking, alcohol consumption and diabetes mellitus were identified as risk factors for acute myocardial infarction. This is in line with the results reported by a regional study by Costa,¹² showing that 71.6% of patients with acute myocardial infarction had hypertension, 71.5% were smokers or ex-smokers, and 45.5% had diabetes mellitus. Also, in a nationwide study on STEMI patients by Wang et al.,³ the main modifiable risk factors identified were hypertension (78.8%), dyslipidemia (57.9%) and diabetes mellitus (37.5%), among others.

Modifiable risk factors such as systemic arterial hypertension, diabetes mellitus, smoking habit, dyslipidemia, obesity, alcohol consumption and psychosocial distress are more common in individuals with lower socioeconomic status; among the indicators of socioeconomic status, educational attainment is the one with the best correlation with the frequency and severity of cardiovascular risk factors.¹³

Door-to-balloon time was longer than the recommended (90 minutes) in 62.4% of the cases. In a multicenter study conducted in public and private hospitals in Brazil, Wang et al.,³ found that 64.04% of 633 patients with STEMI showed a door-to-balloon time longer than 90 minutes. Dharma et al.,¹⁴ in a study carried out in Jakarta, Indonesia, reported that 51.3% of 263 STEMI patients had an inadequate door-to-balloon time. These findings emphasize the difficulty in achieving a satisfactory door-to-balloon time in the management of STEMI patients.

More successful results in door-to-balloon time were detected in studies performed in centers where this parameter has been studied for a longer time, as in the United States, Europe and Asia.^{5,15,16} More challenging targets such as a door-to-balloon time shorter than 60 minutes¹⁷ were achieved by some authors such as Mentias et al.,¹⁸ who reported a median door-to-balloon time of 38 minutes.

Different from other Brazilian studies,^{4,11} the present study did not show the relationship of door-to-balloon with length of hospital stay and mortality rate. For example, Moreira et al.,⁴ investigated the correlation of hospital costs and other variables with the door-to-balloon time (n=141 patients) and did not find any significant difference in the mean length of hospital stay or clinical outcomes between the groups with a door-to-balloon time longer than 90 minutes and those with a door-to-balloon time shorter than 90 minutes. Santos et al.,¹⁹ evaluated the quality of care provided to patients with acute coronary syndrome (ACS) at the emergency department and did not find an association between the quality indicators for ACS (including the door-to-balloon time), and occurrence of complications or death. However, different findings have been reported in international studies, indicating that a reduction in the door-to-balloon time reduces the length of hospital stay, the risk of in-hospital mortality, and even post-discharge mortality at 30 days, one year and three years.^{7,16,18,20,21}

Regarding other component times of the door-to-balloon time that may have influenced the primary outcome, door-to-ECG time ($\Delta t1$) and ECG-to-activation time ($\Delta t2$) showed a significant correlation ($p < 0.001$) with door-to-balloon time. These two intervals represent the first in-hospital stages of care provided to STEMI patients, and in our sample, they contributed to the delay in primary mechanical reperfusion. Some studies have pointed out that delays in emergency services are associated with difficulties related to the staff, equipment and facility, impaired communication in the hospital setting, and lack of priority care.^{5,8,22}

Campos et al.,⁵ showed a reduction in door-to-balloon time from 144 minutes to 70 minutes after implementation of a communication code, a 24-hor screening protocol and presence of a cardiologist at the emergency department of the hospital. Also, pre-hospital electrocardiogram, improvement in the communication between the emergency staff and interventional cardiologists and use of technology in patient data transmission, early activation and direct transfer to the cath laboratory result in a significant reduction in the door-to-balloon time.²³⁻²⁶

This study put the time-to-door time on view; however, its limitation was the fact that it was a one-center study, which limits the generalization of the results.

Conclusions

In our study, door-to-balloon time in the management of STEMI patients was longer than recommended. We did not find a correlation of the door-to-balloon time with the length of hospital stay or in-hospital mortality rate. Door-to-ECG time and ECG-to-activation of a cardiologist contributed to a delay in mechanical reperfusion. These findings indicate the need for monitoring the time components of the door-to-balloon time in the management of STEMI patients in order to reduce the obstacles to a timely coronary intervention by PCI. In this way, proper measures can be implemented to achieve an adequate door-to-balloon time, according to current guidelines on STEMI, thereby promoting a high quality of care to these patients.

Author Contributions

Conception and design of the research: Amoras TSG, Menezes CR, Zaninotto CV. Acquisition of data: Amoras TSG. Analysis and interpretation of the data: Amoras TSG, Menezes CR, Zaninotto CV, Rodrigues TB, Tavares RS.

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Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the *Fundação Hospital de Clínicas Gaspar Vianna* under the protocol number 82951718.3.0000.0016. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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